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(54) **Electrically operable device operation**

(57) A system for operating an electrically operable device (22) comprising support means (12); a number of force sensors (14) mounted on the support means; force responsive means (24) in engagement with the force sensors; manually actuable means (30,32,34,36) acting on the force responsive means and actuable to alter the force exerted on the force sensors by the force responsive means; means (18) for measuring any change in force sensed by the force sensors due to manual actuation of the manually actuable means; means (18) for determining the position of the force application on the force responsive means due to manual actuation of the manually actuable means from the measured force change; means (18) for operating the electrically operable device dependent on the determined position of the force application; and means (18,48-54) for providing a signal indicating operation of the electrically operable device.

Fig.1.

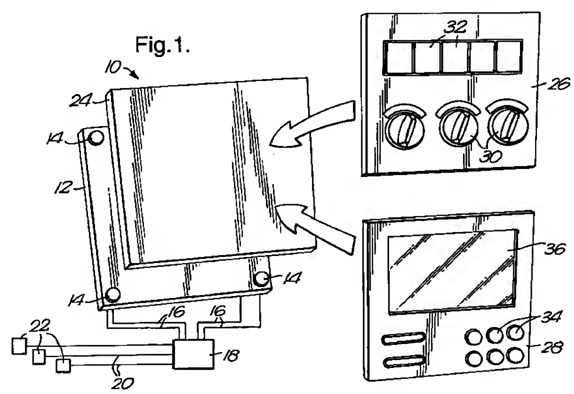
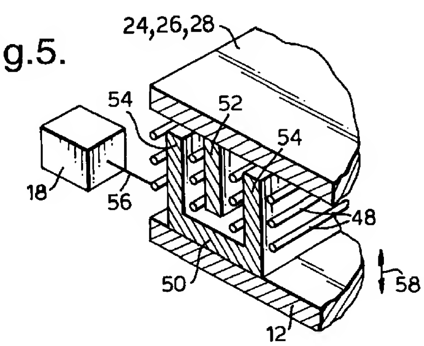


Fig.5.



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Description

Technical Field

[0001] The present invention relates to a system for operating an electrically operable device, and to a method of operating an electrically operable device using the system of the present invention.

Background of the Invention

[0002] Current systems for operating electrically operable devices include conventional switches, and touch-screen systems based on capacitive, ultrasonic or optical technology.

Summary of the Invention

[0003] It is an object of the present invention to provide an alternative system for operating an electrically operable device.

[0004] A system for operating an electrically operable device in accordance with the present invention comprises support means; a number of force sensors mounted on the support means; force responsive means in engagement with the force sensors; manually actuable means acting on the force responsive means and actuable to alter the force exerted on the force sensors by the force responsive means; means for measuring any change in force sensed by the force sensors due to manual actuation of the manually actuable means; means for determining the position of the force application on the force responsive means due to manual actuation of the manually actuable means from the measured force change; means for operating the electrically operable device dependent on the determined position of the force application; and means for providing a signal indicating operation of the electrically operable device.

[0005] The present invention also includes a method of operating an electrically operable device using the system of the present invention comprising the steps of measuring any change in force sensed by the force sensors; determining the position of the application of the force on the force responsive means dependent on the measured force change; operating the electrically operable device dependent on the determined force application position; and providing a signal indicating operation of the electrically operable device.

[0006] The present invention provides a new arrangement for controlling the operation of electrically operable devices.

Brief Description of the Drawings

[0007] The present invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is an exploded view of a system in accordance with the present invention showing two alternative force responsive panels;

Figure 2 is a cross-sectional view through one of the rotatable actuators of Figure 1;

Figure 3 is a cross-sectional view through one of the pushable actuators of Figure 1;

Figure 4 is an illustration of the principle of the present invention; and

Figures 5 to 8 are partial cross-sectional views of alternative arrangements for providing vibration to the force responsive panel of Figure 1 to confirm operation of an electrically operable device.

Description of the Preferred Embodiment

[0008] Referring to Figure 1, the system 10 of the present invention comprises a support panel or frame 12 which is substantially rectangular with a force sensor 14 mounted in each corner of the support frame. Each force sensor 14 is connected by lines 16 to an electronic control unit 18 which is connected by lines 20 to electrically operable devices 22. A force responsive panel 24 is mounted in engagement with the force sensors 14. The force responsive panel 24 may be any suitable arrangement. Two possible alternative arrangements 26,28 for the force responsive panel 24 are shown in Figure 1. The first panel 26 comprises a number of manually rotatable actuators 30 and a number of manually pushable actuators 32, both of which are described in more detail below. In the alternative arrangement, the force responsive panel 28 comprises a number of manually pushable actuators 34 (which are substantially the same as the pushable actuators 32) and a touch screen device 36, which may be a glass panel positioned over a screen. Any suitable combination of rotatable and pushable actuators and touch screen devices may be used in the force responsive panel 24 of the present invention.

[0009] As shown in Figure 2, the force responsive panel 24,26 has a button 38, or any other suitable force transmitting device, in contact with each force sensor 14. Also, each rotatable actuator 30 has a spindle 40 which is rotatably mounted in the support frame 12 and defines the rotation axis A for the actuator 30. Offset from the rotation axis A, and in contact with the force responsive panel 24,26, the rotatable actuator 30 has a button 42. As the actuator 30 is rotated about axis A, the contact point between the button 42 on the actuator and the force responsive panel 24,26 transverses an arc of a circle. As shown in Figure 3, each pushable actuator 32 has a depressible cover 44 which is biased by a spring 46. Other suitable arrangements for the pushable actuator may be used.

[0010] The electronic control unit 18 is a computer based system which is programmed to calculate certain parameters based on received signals, and to send signals to operate the electrically operable devices 22

dependent on the calculated parameters. The electronic control unit 18 is also programmed with certain predetermined parameters such as the distance between the force sensors 14, and the positions of the actuators 30,32 relative to the force sensors. Each actuator 30,32 and/or each position on the touch screen device 36 relates to one or more of the electrically operable devices 22 and how that device or those devices is/are to be operated.

[0011] The electronic control unit 18 monitors the force signal from each force sensor 14. If one of the rotatable actuators 30 is manually rotated, the button 42 on the actuator moves relative to the force responsive panel 24,26. As a consequence of this movement, the force exerted on each force sensor 14 by the force responsive panel 24,26 changes. From the changing force signal from each force sensor 14, the electronic control unit 18 calculates the new position of the moved button 42. The electronic control unit 18 is therefore able to determine which of the rotatable actuators 30 has been moved, and which position it has been moved to. From this determination, the electronic control unit 18 sends an appropriate signal to one or more of the electrically operable devices 22 to operate the device or devices in accordance with the manually selected requirement. Similarly, if one of the pushable actuators 32 is manually depressed, the force exerted by the force responsive panel 24,26 on each force sensor 14 changes. From the changing force signal from the force sensors 14, the electronic control unit 18 calculates the position of the actuator 32 which has been depressed. The electronic control unit 18 is therefore able to determine which of the pushable actuators 32 has been depressed, and from this determination, the electronic control unit 18 sends an appropriate signal to one or more of the electrically operable devices 22 to operate the device or devices in accordance with the manually selected requirement. The electronic control unit 18 can be used in the same manner where the force responsive panel 28 has the touch screen device 36. Manual application of a force at a selected point on the touch screen device 36 will change the force being applied by the force responsive panel 28 on the force sensors 14. From the changing force signal from the force sensors 14, the electronic control unit 18 calculates the position of the application of manual force on the touch screen device 36, and operates the appropriate electrically operable device 22 according to the manually selected requirement.

[0012] The basic principal of the present invention is shown in Figure 4. Application of a force F at a point P(x,y) on the force responsive panel 24 will change the force on the first force sensor 14 by F_1, on the second force sensor by F_2, on the third force sensor by F_3, and on the fourth force sensor by F_4. From the following equations:-

$$(F_1+F_4)/F = x_2/(x_1+x_2)$$

$$(F_1+F_2)/F = y_2/(y_1+y_2)$$

$$(F_2+F_3)/F = x_1(x_1+x_2)$$

$$(F_3+F_4)/F = y_1/(y_1+y_2)$$

the values of x_1, x_2, y_1, and y_2 can be calculated, and hence the position P(x,y) can be determined. The present invention works by sensing the application of a force to a force responsive panel 24 within an area bounded by the force sensors 14.

[0013] The electronic control unit 18 may also monitor the status of one or more of the electrically operable devices 22. For example, the first force application to a pushable actuator 32,34 may indicate that an electrically operable device 22 is to be switched on, and the second, subsequent, push on the same actuator will indicate that the same device is to be switched off.

[0014] The electronic control unit 18 may be programmed to monitor the speed of the change in force on each force sensor 14, or the absolute value of the applied force F. This arrangement can be used determining the amount of operation of one of the electrically operable devices 22 (for example, the required speed of an electric motor, temperature setting), or for detecting emergency situations.

[0015] The pushable actuator 32 may have include a spring 46, as mentioned above, which provides a form of feel or feedback to the operator that the actuator has been actuated. Such a feel or feedback is not available with the touch screen device 36. Also, it may not be apparent to the operator that the electronic control unit 18 has received the signal to actuate one of the electrically operable devices 22 as requested by the operator's manual actuation of one of the actuators 30-34 or the touch screen device 36. To overcome this potential problem, the electronic control unit 18 may also be capable of sending signals to a visual or audio device (not shown) to confirm operation of an electrically operable device 22. In a preferred arrangement, however, the electronic control unit 18, on sending a signal to one or more of the electrically operable devices 22, substantially simultaneously actuates a device (as described below) which vibrates the force responsive panel 24,26,28 for a predetermined amount of time. The vibration of the force responsive panel 24,26,28 will be felt by the operator to provide an indication that the electronic control unit 18 has actuated the electrically operable device 22 as required by the operator.

[0016] Examples of devices for vibrating the force responsive panel 24,26,28 are shown in Figures 5 to 8. In Figure 5, a coil 48 is positioned around a U-shaped core 50 secured to the support frame 12 or some other support member, and a magnetically responsive leg 52 is secured to the force responsive panel 24,26,28 and positioned between the arms 54 of the core 50. The coil 48 is connected by a line 56 to the electronic control unit 18. On sending a signal to one or more electrically oper-

able devices 22, the electronic control unit 18 also sends a signal to the coil 48, causing the leg 52 to vibrate in the direction of arrow 58, and hence causing the force responsive panel 24,26,28 to vibrate. In Figure 6, a V- or U-shaped leaf spring 60 is secured between the force responsive panel 24,26,28 and the support frame 12 or other support member. A solenoid or other electromagnetic device 62 with a shaft 64 capable of translational movement is secured to the support frame 12. The solenoid 62 is connected by a line 66 to the electronic control unit 18. The shaft 64 is connected to a central portion of the leaf spring 60. On sending a signal to one or more electrically operable devices 22, the electronic control unit 18 also sends a signal to the solenoid 62, causing the shaft 64 to vibrate in the direction of arrow 68, and hence causing the force responsive panel 24,26,28 to vibrate in the direction of arrow 70. In Figure 7, a solenoid or other electromagnetic device 72 is mounted on the support frame 12 and has a shaft 74 which passes through a bearing 76 on the support frame and is secured to the force responsive panel 24,26,28. The solenoid 72 is connected by a line 78 to the electronic control unit 18. On sending a signal to one or more electrically operable devices 22, the electronic control unit 18 also sends a signal to the solenoid 72, causing the shaft 74 to vibrate in the direction of arrow 80, and hence causing the force responsive panel 24,26,28 to vibrate. In Figure 8, a coil spring 82 is secured between the force responsive panel 24,26,28 and the support frame 12. A rotatable cam member 84 is positioned between, and engageable with, the force responsive panel 24,26,28 and the support frame 12. The cam member 84 is connected off-centre to a shaft 86 which is rotatable by a DC motor 88. The DC motor 88 is connected by a line 90 to the electronic control unit 18. On sending a signal to one or more electrically operable devices 22, the electronic control unit 18 also sends a signal to the DC motor 88, causing the shaft 86 and the cam member 84 to rotate, and hence causing the force responsive panel 24,26,28 to vibrate in the direction of arrow 92.

[0017] In the present invention, any suitable number of force sensors 14 may be used. Also, the support frame 12 and the force responsive panel 24 may be any suitable shape.

[0018] The present invention has particular application in motor vehicles, and the force responsive panel 24 could, for example, be mounted in the dashboard of a motor vehicle, and be used for operating any one or more electrically operable devices, such as internal and external lights, windshield wipers, air conditioning fans, audio equipment, etc. In such an arrangement, the support panel or frame 12 could be provided by the dashboard.

Claims

1. A system for operating an electrically operable device (22) comprising support means (12); a number of force sensors (14) mounted on the support means; force responsive means (24-28) in engagement with the force sensors; manually actuable means (30-36) acting on the force responsive means and actuable to alter the force exerted on the force sensors by the force responsive means; means (18) for measuring any change in force sensed by the force sensors due to manual actuation of the manually actuable means; means (18) for determining the position of the force application on the force responsive means due to manual actuation of the manually actuable means from the measured force change; means (18) for operating the electrically operable device dependent on the determined position of the force application; and means (18,48-54) for providing a signal indicating operation of the electrically operable device.

2. A system as claimed in Claim 1, wherein the manually actuable means comprises an actuator (30) which is manually rotatable about an axis (A), the actuator having a button (42) which is offset from the rotation axis and in contact with the force responsive means (26).

3. A system as claimed in Claim 1, wherein the manually actuable means comprises a manually pushable actuator (32,34).

4. A system as claimed in Claim 1, wherein the manually actuable means comprises a touch screen device (36).

5. A system as claimed in any one of Claims 1 to 4, wherein the force responsive means (24-28) has a button (38) in contact with each force sensor (14).

6. A system as claimed in any one of Claims 1 to 5, further comprising means (18) for monitoring the rate of change of the force sensed by the force sensors and/or the absolute value of the applied force; and means (18) for operating the electrically operable device (22) dependent on the monitored rate of force change or the absolute value of the applied force.

7. A system as claimed in any one of Claims 1 to 6, wherein the support means is a rectangular panel or frame (12), and wherein a force sensor (14) is mounted in each corner of the panel or frame.

8. A system as claimed in any one of Claims 1 to 7, wherein the means for providing a signal indicating operation of the electrically operable device (22) comprises vibrating means (48-54) connected to the force responsive means (24-28) and causing vibration of the force responsive means when an

electrically operable device is operated.

9. A system as claimed in Claim 8, wherein the vibrating means comprises an electromagnetic device (48,50;62;72) and a member (52,64,74) capable of translational movement by the electromagnetic device.

10. A system as claimed in Claim 8, wherein the vibrating means comprises a DC motor (88) and a cam member (84) capable of rotational movement by the DC motor.

11. A system as claimed in any one of Claims 1 to 10 for use in a motor vehicle.

12. A method of operating an electrically operable device (22) using a system as claimed in any one of Claims 1 to 11, comprising the steps of

measuring any change in force sensed by the force sensors (14);
determining the position of the application of the force on the force responsive means (24-28) dependent on the measured force change;
operating the electrically operable device dependent on the determined force application position; and
providing a signal indicating operation of the electrically operable device.

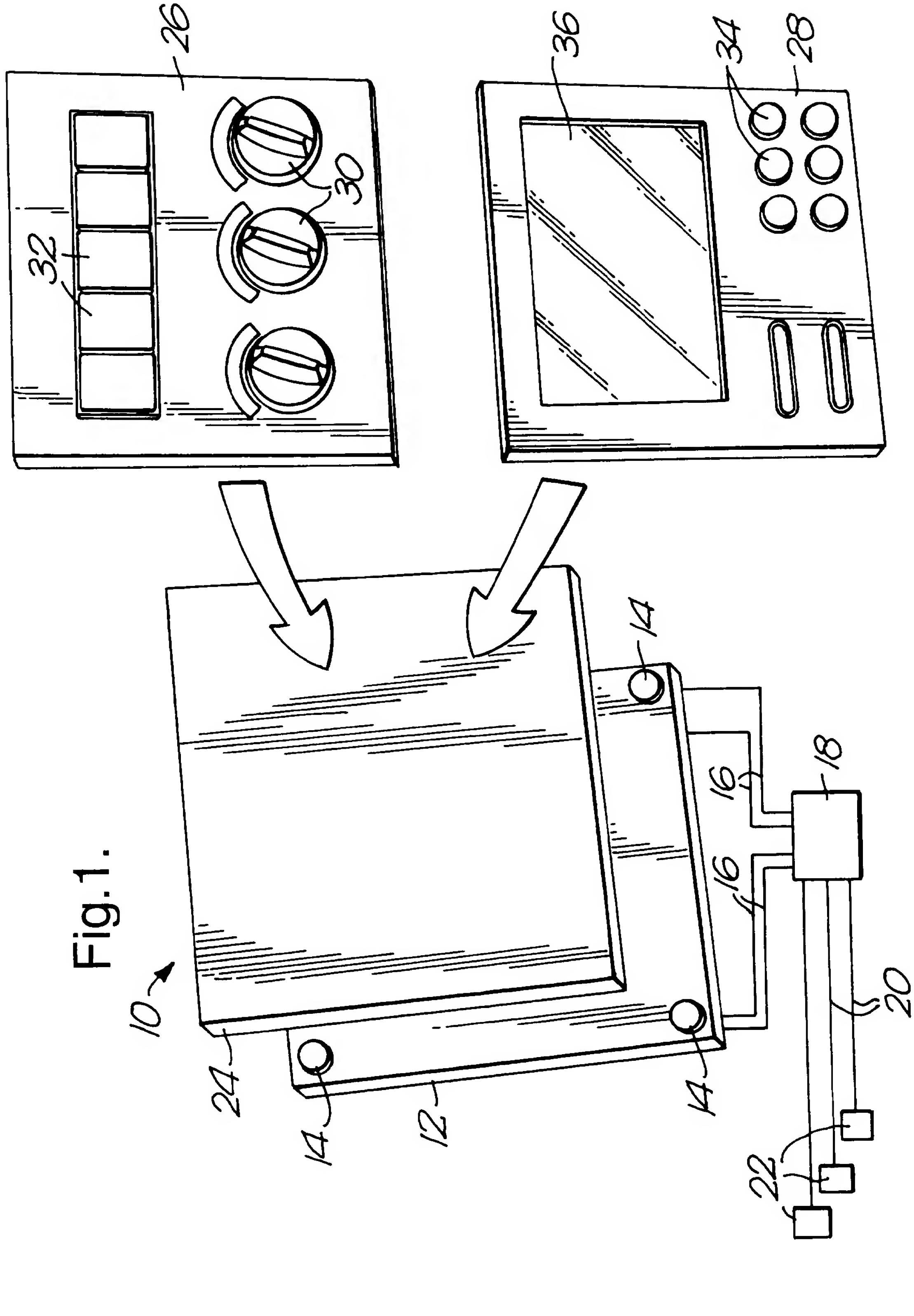


Fig.1.

Fig.2.

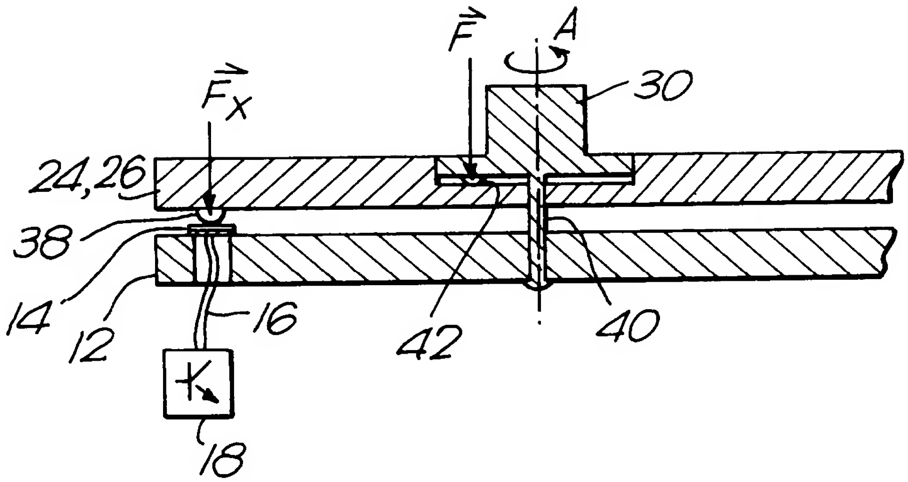

$\vec{F}$
A
30
$\vec{F}_x$
24,26
38
14
12
16
42
40
18

Fig.3.

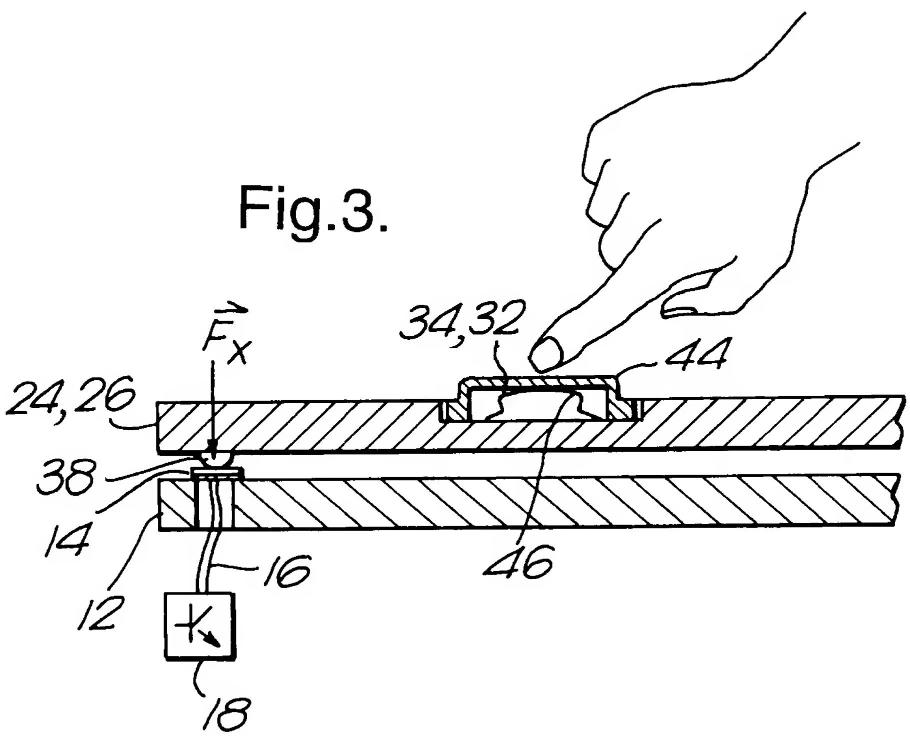

34,32
44
$\vec{F}_x$
24,26
38
14
12
16
46
18

Fig.4.

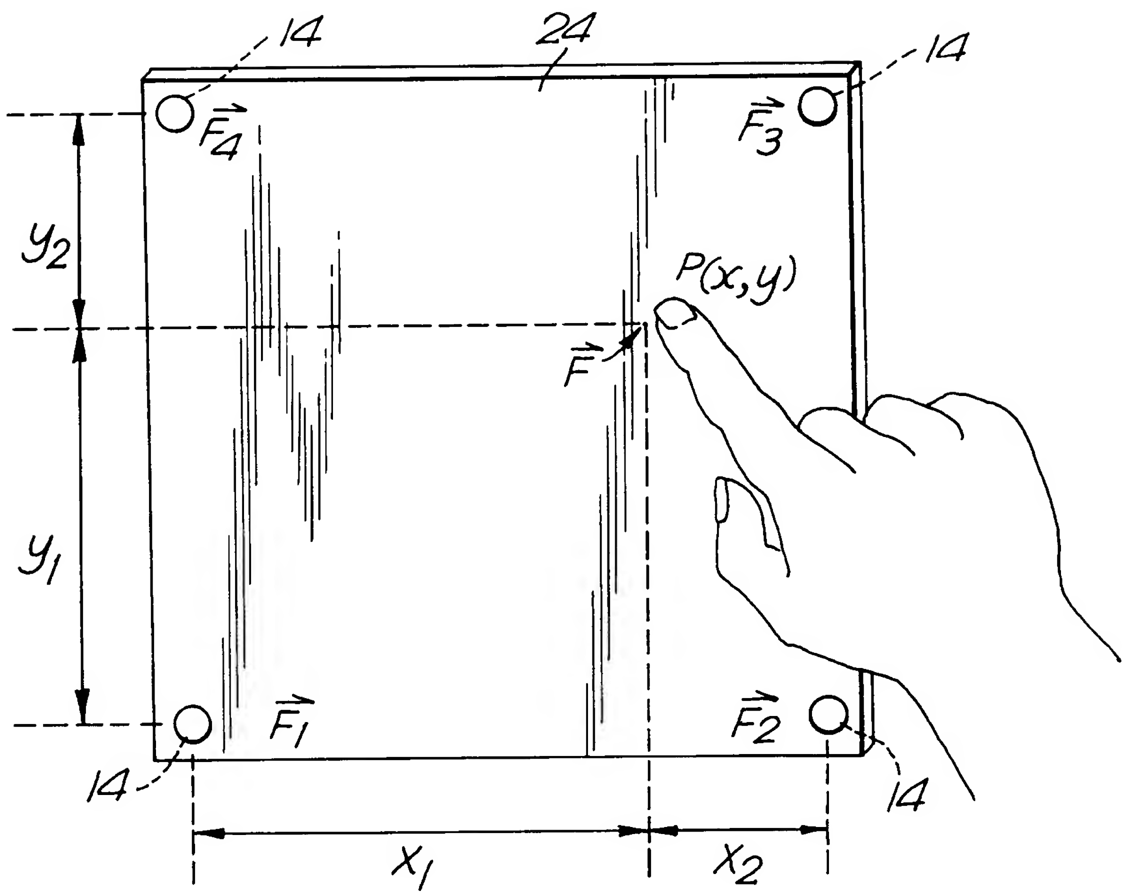


Fig.5.

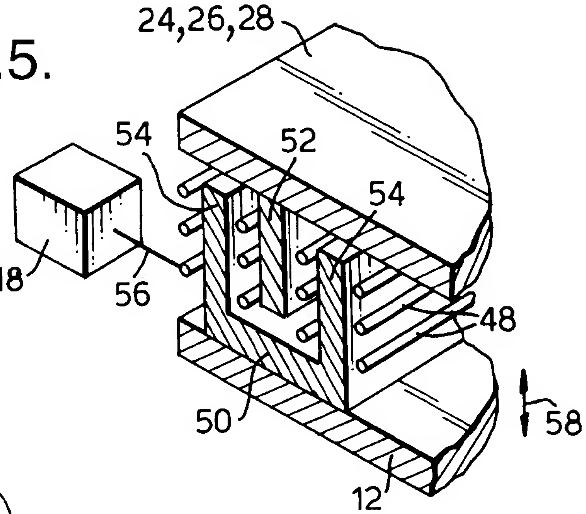


Fig.6.

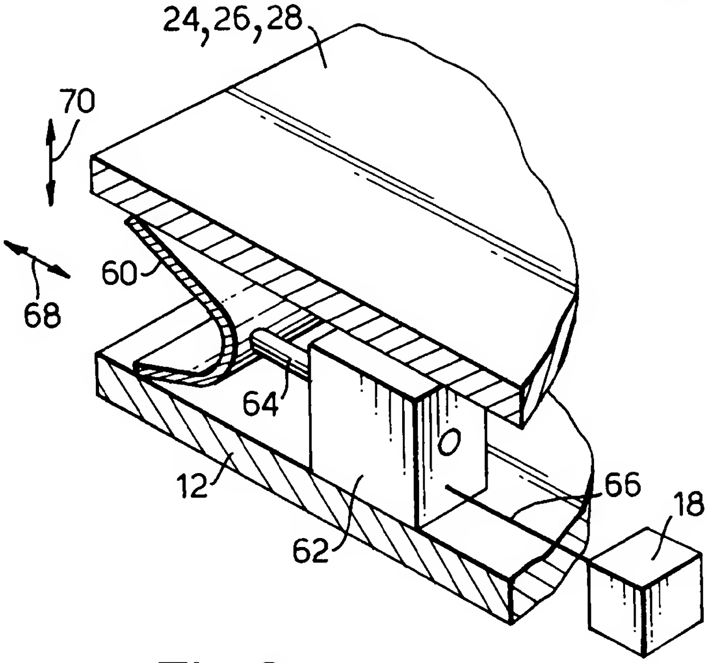


Fig.7.

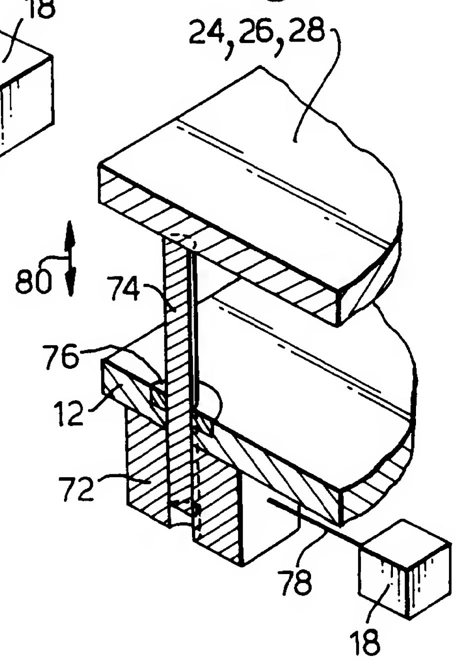
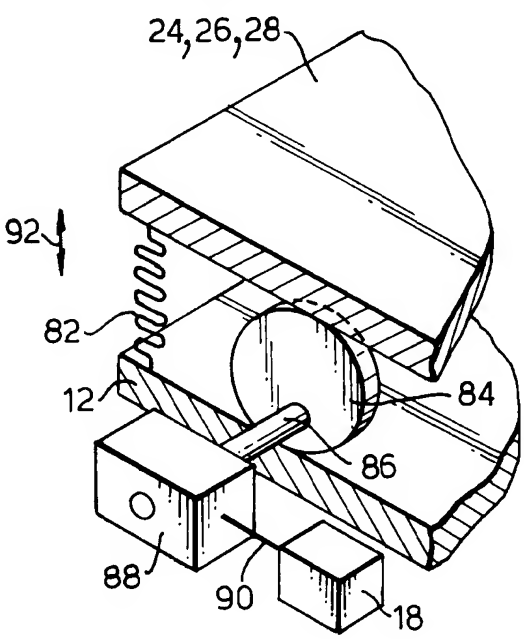


Fig.8.



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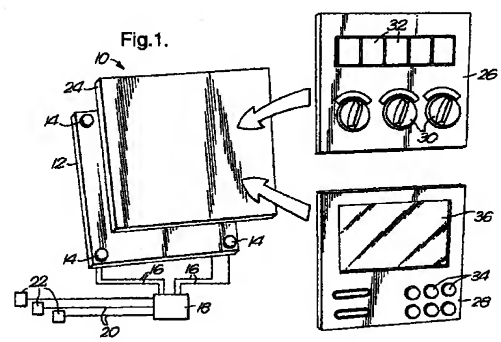
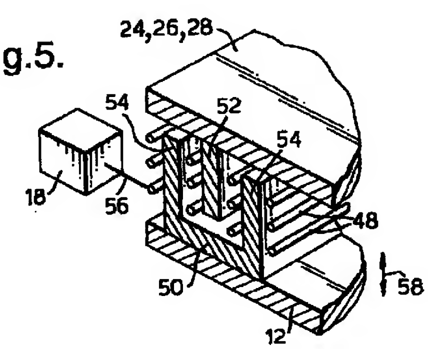


Fig.5.



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EUROPEAN SEARCH REPORT

Application Number
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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	EP 0 638 508 A (INVENTIO AG) 15 February 1995 * column 2, line 43 - column 4, line 7 *	1,3,5,12	H03K17/96 G06K11/16
A	EP 0 388 346 A (IBM) 19 September 1990 * column 9, line 23 - line 35; figure 3C *	4,6,7	
A	EP 0 489 344 A (IEE SARL) 10 June 1992 * column 6, line 18 - column 7, line 28; figures *	4	
A	US 5 638 060 A (KATAOKA ICHIRO ET AL) 10 June 1997 * column 6, line 4 - line 6 *	8	
A	US 4 543 562 A (NY NILS O) 24 September 1985 * column 2, line 22 - line 30; figure 1 *	4	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
H03K
G06K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26 February 1999	D/L PINTA BALLE.., L

CATEGORY OF CITED DOCUMENTS

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